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(73) Proprietor: Al'tshuler Grigorij Borisovich

(54) APPARATUS FOR LASER TREATMENT OF BIOLOGICAL TISSUES
(ALTERNATIVE EMBODIMENTS)

(57) Abstract:

FIELD: medical engineering; surgery; orthopedics; stomatology. SUBSTANCE: proposed apparatus comprises at least one receiver of information about condition of biotissue to be automatically controlled. Receiver output is connected with input of control unit. Apparatus further comprises electronic switches arranged in current supply circuits of lasers and controlled by output signals issued by control unit. Finally, apparatus comprises two or three lasers emitting radiations at different wavelengths and having independent outputs. EFFECT: improved design. 7 cl, 5 dwgs

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(51) Int. Cl: A61N5/06 A6105/00

(56) References cited:

WO, naTeHT, 90/12548, mu. A 61 N 5/00, 1990.

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(54) **YCTPOYICTBO J-JISI JIA3EPHOLI** OBPABOTKLI BVIOJIOP¹⁴ IECKOLI TKAHII
[EPO BAPIPAHTbI]

(57) Abstract:

I'ICHOnb3oBaHHe: H3o6peTeHHe OTHOCHTCa K MeJLHL HHCKOLI TexHHKe H MO}KeT *6bITb*
HeHonb3onaxo B xHpyprHH, opTone **nu u** cToMaTonomH. CynrocTb H3o6peTeHHcI:
aBTOMaTH¹⁴CKHe KOHTpOlb COCTOHHHCII o6pa6amlBaeMoti **6HOTKaHH** H ynpanneime
napaMeTpaMH H3nyleana na3epoa RocTuraloTCSI 6napoj;apsi CoBOKyrHOCTH BBejeHHbix B
ycTpocTba xOTb 61 OJHOO IIpICMHHKa HH4)OpMalHH o COCTOHHHH 6HOTKaHH, BbIXOg
KQTOporo coecHHcH c BXOjOM 6noia ynpasneHux, H 9MOKTpOHbIX x.mocTeJL,
ycTaBOBJIHHbIX B JienSIX rHTaHHcI na3epOB H ynpaBaeMbix BbIXOJ(HbIMH CH:HaHaMH
6noxa ynpaHeHHcI. Hanm ¹He B OAHOM yCTpOICTBe AByX HnH TpeX na3epou c pa3TDX'mblMH
,HnHaMH BOTH H3ny⁴HeHH2 H He3aBHCHMbIX BbIXOgOB, a TaKKe B03MO)KHOCTb
CMemXBaHHH H3nyeHHH 9THX na3epOB o6ecnex-nIBaeT B03MO)KHOCTb Tpe6yeMOro,
OpHeHTHpOBaHHO:O Ha MHHIMaJbHyIO HHBa3HBHOCTb pe)KHMa o6pa6oTKI. 5 yin.

-£-

l411OXI9a 'ISNHaaEduX E310119 r10uox 3 H2HHM03 tfoXI9a E 'RHExL EH NHHLLonattfOa
no,L3aw a Halaudio3 oIodo,Lox Ioxa 'NHBxs kIOxaahL10110Ng NNNHO.L303 o NLIYEI^d0(J)H1
M11ny I4du Hato I4g H.LOX Hatfaaa 'EH.LONod.Latt NIOtoX14a N2x3ahw.Luo Ha.Launau o.Iodo,Lox
tfoXI4a 'Y40NHhafoHEH 3 OHBOUGH 303133hLLUO YN ANaLJHO oiSm0(rtdhaLxo(I) EdafEu
Ojodo.La 1130 903133hLLUO EH 0lmhH3UHOHE.La2C 'OHBOHLLasaal.L003 aodafEu o.odo.La N o oadau
XHoo EH I9Haxcououad alado,L0H 'Euemdaf EdafEU o.Iodo.LH mama 'P^Hauh' H11tf aeahEdfOdu
H Bda£8u oloadau Imliuoa lunwh' Huff aox9uaLawad,Lo oHHN,Lxauaa u al^4ua,LaXcad,Lo
az4HHawlcduoa Nxaanz uo 'T414uaauedau XI4do,Lox Nao 3031aah0,L110 'I9dafEu al^Ho'uXul^N
'aodafEu ISNHLLNU PtoIoUg a I9H3H1H1303 oaoDo,Iox I4tfoxi a 'ISNHaaEduk 310119
aatna3adaffoa 'HHExx H0XaaB0L1O110H9 113Is09Ed90 Vonda£Eu IsuY1Oa,LoNod,Latt h O,Lb 'NaLL
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oaa 9,1,a0HaN,Lx344E 11eHhO,LE,L3o113H Ha.L3B1CHH ELaLoLodu Niox,LE.L.OOtfall HhaHHOHOo

•OjOdO.La KNHahAu'EN I914nou I9HLlutf ^ulf aouhld£odu H EdafEU o.Ioadau HNHanetufEH
rnuaoa i^H1Hute Butt aoH4ua,LExced.Lo OHa0LLxauaa a L '30Hh1Odxf11 EdafEU oouodo,La
Hao EH£ 'aoH4uai,g a d,Lo 'adaceu oJoadau moo EH 3oHH3K0Ihou0Ed 'OUExdaC^440H310110H
I^111313ahN,LUO h HOPIa,L3113 zgatnoLcdH3Ac00S 'I£0903 RfxiaNt a9xHaHCHduo3 NxaahMLUo
'eHBMdaf 1111330 3o917 F101LLC tfou I9Haxcouou3L'd aoda£BU X0090 XL130 XHXaaHLL,LUO
EH 'I^OXNhh3110BEH 3 B11310110a O.IOxaahH,LUO 310£d23A H A Ia.L3H3 ouQHO&dH0xOH
'edafEu oaoDo.La u3o HOHaahH,LUO EH aI9HHawouou3L'd 'I4H9uauuedeu xlgdo,Loa
I130 aHxaahH,LUO 'edafEU xrnla4UlcIn a eat('HNHau aduA 310u9 J modatffoa oal.Oaod0.o& o.L£

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'Ea.LOljod.L3 notfox4a HO.Launaa ^tfoxI4a E 'HHBOH10a O.IOMOahHLLNO P10H1OXI4a 3 Haxcuduo3
11M03hMLUO O.Iodo,L0x^oxa OHHhDH0HHB H 'Eda£Eu vttoftorI^o o HaskHduoa HxaahMLUo
oaoDsox t1OXH 'aH310110a 0103133hLLUO xofads0 331110(EhOtU)Ia '69ICE x 1111HahCIEH
HxaE iootf oal.Otfad3 H dafEU grum^acU^m Ha0 ROxaahHLLUO 4uofa 319HH3)1C0L1ON3Ed
oh^uaLEaotfaaou aa2HBaxdaffoa 'Y0££0,so H1H1ExylugS1 E^LB1 '00/9 O 19 V 'L0610/06
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a OHBaO£4u0I13N 4s149 .L3MCONI H 31Nxxa.L U0x3HN11NfaNI x 18O.10u011,1,0 aaHasadgofyI

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*HHHauaadud Exoug 14EZfoxl4a
 x H1iIKUIHahOAMAttOU 'HNEHELI ita HNI²HJ.HHLENIODj.xauc HaxC9EH3 HNIEToaoduottttgOa
 IsHHaHhHiaO0 aJaaNI a dooaaDuNiox *alg arAlGOH E 'EHJ aHODj a~i HNIETfoXI9a Lu'u9Hhou' IEJHdda*
ISOLOH LcaU H XEAHHHahO3I H a 14HOHH11a1L90 x1²do.Lox 14tloxi a 3HiUOIAa,LaaJ,003
*'Edo3aadu*loX o.loi ma tfoa H Nloaooaa NniT 1foa Igloa Trutt EdEAda²ad fli*
 v Januso.Laoa 'nni ogadgo MHO²gHHHamfodo HON1aj.3HO OHa3H9EHa oa,Loada.adc oueua.LIHHUouorj

*ISua.LEhollnladau o ioi 14iCdXuaoDJ.xauc
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 aHHauHEdIEEH O.Lh 'NIOcEdgo NHME.L 0.10HHauBOHE.1a4C 'EaHHNlandu 0.103IaahL.L3jMe att H' a
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 l' mH2foxl4a *A'xwan* EdacEu moo HoxaahH.LUO EH oarwaxrououaEd 'EUExdae ouoiw.odoaou
 woa.Latiad3ofh gHEIL EH ISHa.LoHaticoa 11O.Laa14 a *nO'4* duoa HHOObHJ.uO o odoxo3l
 1oxa 'ISHHahAu²gH Oj0HoadBE4HH Ex11HNlaadu o.1oxaahf.d.Lxauco.Lo4 attaa a nauou 4a
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*ISHHanaEda E.LHaNlaue H aodioaxalfai.o.4
 HM IaHHU 'E LHaWauc o,10HHOH3dau3Htt fH 0.1321HSO.La03 11 YHEX.L Eii ISHU.Lal/latfGoa NIO.L33NI
 a Haxcxduoa Hxa0hHLLUO o.IOdO.LOM tiOxa 'NH **o051-o0Z** HL0EI90 H Edo.LEfHUEHEOd.Lxaui attHa
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 variorum x14HHQd&.xauE HNEIfoa a 14110HH1la0a o.10do.LOX IglioXiga 'HnHallandaA
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 o.Iodo.IAx tIOXa 'HnExJ. UO313ahL.I0HOU9 HHHHIO.Laoa o MHZENIdolHH NIOMHHNloadu NIHHIO
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 ELCEXdae a1²E4uaj.EHCEdO Nlahldu 'ouRxdac a OHg1la.LEIOEdO oHa1jHOHE.La *HeO*
 Oda EH E. 'aOdacau xLIAdif xAall NIHO0 I'QHxaahJ.JHO EH44fauidau O.IOdO.LOH 400 ISEX3ahHJ.110
 'beau ur'a13quICUN² va.LadL Hatfuaa 'aajo odJaA woliex14a N1HMOOH0HJ.J110 HaLoauaa
 O.IOdO.LOH tIOX14a 'YQOX1HHaHOMEH a OHXOH0a a0310ahLUO 11 *aro* LOHO of no AdaaA *io4* adacau
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 al4Ha4H.fuv4a 'aoda²gEU HarrexaU Laxou9 a 14FI3H11tfaoa oIodo.Lox 1a1laxlga 'ISHHafaa/~
 x0119 aaluExcdatfoa '1HHEX.L HOxaahH.I0noI9 11MJA9Edg0 IgoHdaceU Hull OHJ oYIOdJa/~
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 11 E14JaMa HEZHoL dHa2cxotr EHaHC011ouOED ISHHah1d1e1 & fox ou oHg1L2.LEHOH11a1a0
 EdacEu oaoadau H30 VOs3ah1J.U0 EH E 'H1HaAl(gH EZIOX CH Oda Ettoa14a o14j0oHJ.KOYQEOa
 3 0HO11aOHEJatt OHExdae aoi4L.Ca.LExCedso *H ared,au YQOXou9 3 EdacEu alOIJ)KEM H1HOHHtfaoa
 xHildl a X19HHalfao4reLo '1~a001lfX XlquiHodJ.xauc HY4EtOXa a 14HoHh11eo3 ouodoxox

143BeCTHO, 'ITO 9 4eKTHBHOCTh na3epHOH o6pa6o'rKHN 6Nonorxtecxolz TKann C OTpHOBeMeHHHM o6ecne'ieHHeM H113KO2 NHBa3NBHOCTN (CreneHH HeKp03a) 3aHHCNT OT MINHbI HOTHBbI N MOHJHOCTN na3epHOH N3nyneHHH, 3Heprnn N HpeMeHH na3epoxo B03TjeHCTBHH, a TjHH HCKOTOpbIX BHTJOB TKAHH 3KHTTJKOCTHOpo OromeHHH 30HbI na3epHOH o6pa6o'rKHN (cM. HanpMep Proceeding of. Laser-Tissue Interaction V 24-27 January 1994, Los Angeles, California Vol 2134A).

NecnegofaHHH, npoBeJieHHMe anToMoM, noxa3anL, wro npN 9ToM Heo6xoJHMa OT(HoBpeMennaB OnTNM3a11 1st yKa3aHHbIX napaITpoB a c p Ka c opO Bill a 6NOTKAHH. H4HBIMN CnOaBMN, HeoXOT(HMbI: B03M0)KHOCTh Bb160pa OHTNMajbHBIX MHH BOMH N3ny'ieHHH na3epo rum Nx CMedu, perHCTpaunH npoecca na3epHOH TjecTpyKB;NH, BNTja N COCTOHHH 6NOTKAHN N ynpaBneHH TjnlHOH HOHH, MOHBOCTHO, 9HeprLe2 N BpeMeM na3epHOH TjeicTBN51, cHcrema OpoineHHH 3OHM na3epHOH o6pa6oTKN.

COBOKpHOCTb BBaJieHHbIX B yCTPOLICTBO XOTbI 6b1 0,14HOpo npaMHNKa 14H4OpMaljIH O COCTOHHH o6pa6aTbIMaMo aonorHuexon TKAHN, BbIXOT TOTOPO COCTHHeH C BXOgOM 6noKa ynpaBneHHH, N 9eKCTPOHHbIX Kalloue2, ycTaHOBJeHHx 1x Bb1em nTaHH na3epOM N ynpaBneMbix BbIXogH IMN cHrHanaMH 6noKa ynpaBneHHH, npejicTaBHHOT co6oH CNCTeMy o6paTHOH CB513N, KOTOPa o6ecneHHBaET an'poMaTN 'ieCKHe KOHTpOlb N OHTNMajbHOCT ynpaBneHH napaMeTpaMN Harly 'ieHHH na3epOB B 3aBHCNMOTCTB OT BHT;a N COCTOHHH o6pa6aTbIMaMo2 TKAHH N 'rem CaMbIM o6ecnewBaET MNHHManbHyo HBBa3NBHOCTb.

Heo6xoJaMoTb aBTOMaTH'ieCKHX KOHTpOlbH N ynpaBneHHH Bb13BaHa 'iaCTO B03HKA1011jeH HeB03M0)KHOCpb10 B143yambHOPO OnpCTjeHHH Hpa'IOH COCTOHHH o6nyiaeM05I TKAHN N ee BHTja.

Hanatlae 7,7y; HC313HCNM:IX BbIXOT(OM B OT HOM yCTPOICTBe 6napOTjapH B03M07KHOCTh Bb1BOTja OTpaKaTenbHOPO 3epxana 143 xOT(a 13JbTeHHH Hlepnoo na3epa, a TaKJKe B03M0)KHOCTh CMeuJLbaHHH 143JbyUCHN2 TjByX na3epOB HOBBHaeT 9(4eKTHBHOCTh pa6OTbI ITN o6pa6oTxe 614OTKAHN N o6ecne'mBaET CHH)KCHHe HeKp03a - - - - -

HanatlHe H OT(HOM yCTPONCTBC T(n51 o6pa6OTKN 6NonOrrmeCKo2 TKAHN TpeX na3epOH C pa3HH'bHM TjH)KaTenbHOPO 3epxana 143 ny'ieHHH N He3aBHCNMbHM BbIXOT(aMN H C B03M0KHOCThO CMenHbaHHH N3ny'ieHHH o6ecne'iaBaep HaN6OmblyIO M06HJbHOCTb npaMeneHHH yCTPOLICTBa N MaCKMambHO pacmJape' ero H03MOXHOCTh. HanpIMep, npN OTJHOBeMeHHOM B032(eICTBHH POnbMHeHHM H HCOJNMOMbH na3epaMN Ha o6NnbHO KpOBOJiaubHajoule opaHbI CHNMaeTCH OhaCHOCTb KpOBOTe'ieHHH npN HeCaHKH,NOHNpO6aHHOii nep4opalj1N KpyHHbIX KpOBeHOCTbIX coCTyOB, MIA CMeYHBanSI N3ny'ieHHH TpeTepO na3epa c T(ByMH T(pyTLMN Hm Ka?KT(b1M 143 MXX BBCgCHb OTpaKaTenbHOe H ceneKTNBHOe 3epKana, ycTaOBneHHble COOTBCTBCHHO K OCSIM TpeTbCrO N DTOPON 11a3epOB, a B03M07KHOCTh Bb1BOTja OTpaKaTbHHX 3epxan N3 OTTja 1131y'ieHHH 14 HanJie T(OHTHH4TCHbHM ~OKyCNpyIOH)TDC CNCTeM H OHTN'icCKHX BOHOKOB o6ecne'iaBaET He3aBHCNMOCTh TpeX OHTN'ieCKHX BbIXOT(OB yCTPOICTB.

AOJIOJHHTenbHO BBe)CHHaH B yCTPOLICTBa CHCTeMa OpoineHHH, ynpaBHeMaH 3eKCTPOHHbIMN KJianaHaMM, IOI(KnIO'ieHHbIMN K BbIXOTaM 6nmKa ynpaBneHHH, o6ecne'iaBaET onTNManbHOe cogeTaHHe pe?KHMOH o6nyneHHH N OpoHeHCH TKAHN.

COBOKyJHOCTb N302KieHHX B 4 opMyne N306eTeHH31 npJ3HaKOB HbaHeTCH HOBOJI, a canto TeXHN'ieCKOe pemene yHOBJICTBOHCT KpITe3110 "14306eTaTenCKNJI ypOBeH".

Ha Ipar.1 N306pa?KCHa CXeMa ycTpoicTBa Tjns na3epyo i o6pa6oTKH 6NoTKAH; Ha 4Nr. 2 CXeMa yCTPOLICTBa npH Hana'n4N TpeX na3epOB; Ha (MP. 3 CXeMa BapHaHTOB BbHOJHCHH H pacnon02KeHHH npHeMHbIKOB HHd opMaHNN O COCTOHHH o6pa6aTbIMaMo2 6NOTKAHN; Ha tMr.4 cHeTeMa opoieyelln 30HbI o6pa6oTKN; Ha (DNr.5 6nox-CXeMa 6noia ynpaBneHHH.

VCCTPOLICTBO aH na3epHOH o6pa6OTKN 6nonorH'iecaok TKAHN 4Nr.1) COCTONT 143 6noKa ynpaBneHHH 1, COe.(NHeHOpo c H14M 6noxa nTaHHH 2, NMnybCHbIX na3epOB 3, 4, co3j HHCbHbIX c 6YOKOM nTaHHH 'ie3e3 3eKCTPOHHbIX KnIO'HN 5, 6, KOOToble no KnIO'ieHHH

K BbIXOgaM 6ноха ynpaBneHHn 1. Ha onTLIuecKnx coax нacepOB 3, 4 пaсnono?xeHbl CoOTBeTCTBeHHO OTpaKaTenbHOe 3epKaJO 7 н CenexTMBHOc 3epKaJO 8, KoToпbлe onTHuecKII coпpH KeHbl MelKgy co6oa c (поKycHpyионjeЛ eneTeMol 9 H BblXOgHblM ToпpIOM onTHueCKOpo BOIOKHa 10 c HaKOHe "HHKOM 11, пaсnono7KenbIX Ha OHTMUP.CKO\$ oca на3epa 4. CeneKTIIbHOe 3epKaHO 8 OTpaKaTeTbHO гнсл H33ly'ieHHn c гTIIHHOH BонHbl на3epa 3, no npo3пaтuo Knn H3nyueHnn c гHHO\$ Bonи на3epa 4. Пaсnono)KeHHoe Ha OHTHueCKOH OCH на3epa 3 OTpaKaTenbhoe 3epKaHO 7 нOгKpHOUeHO K BbIXOgy 6ноха ynpanneHnn 1 H B H0102KeHHM A ycTanaBnnnaeTCn nog yrhoM 45° x ocil, a B nonoixeHHDI B napanneim o efi. Ha 9TOLI lice oCH ncneg 3a 3epxanoM nocneijo BarenbHO no xony M3nyueHHM пaсnono3eln 1 4)oxydHpylonjan eneTeMa 12 n onTHuecxoe BOTIOKHO 13 c HaKOHeHHKOM 14. **K** BXOgy 6ноха ynpanneHH 1 nogxmo"eH 3neKTpnyeCKHI BbIXOA npMeHHKa HH(popMauiи o COCTOHHHM 6HonopneCKoi TKaHи 15, BXOg KOTOpO COпpHHeH c MeC'TOM B03jellICTBHH Ha 6HOTKaHb 16. CHCTeMa nпpax nzi 17 no)jUnIOUexa K TeM KC BbIXOJaM 6ноха ynpaoneHJIISI 1, 4TO 11 6нох нHTaHHH 2, a ce Bo \$HOYi n Bo3,ByIBHb11 BbIXOgl 18 M 19 o6'egmeHbl B HaKOae "HMKc 11 (14).

Ha (Dnr. 2 nпeгeTanneH BapHaIT ycTpoICTBa c TpeM\$1 на3epain 3, 4, 20. Ha onTz1 eeKovi oCM на3epa 20 ycTaHOBeHO OTpaKaTenbHOe 3epKaHO 21, KOTOpoe Tax Me, Kax H OTpaKaTenbHOe 3epxano 7, nogKnoyexo K 6нOxy ynpaBneHии 1, H B nonO)KCHHH A yCTpaHBaebTOH nog yrhoM 135° K onTHueCKOH OCH, a B HonO)KeHHM B - napannebnoc eLI. Ha 9TOLI lice onTIIuecxoi oca пaсnono)Keubl 4)оKycлpylonia\$ cHCpeMa 22 H BXOgHOЛI Toпeу onTHueCKOpo BOIOKHa 23 11 HaKOHeHHKOM 24. MewKny (поKycнpyионjeЛ eHCTeMo 9 H CeTleKTHBHHM 3epxanoM 8 ycTaoBneHO BToпoe ceneKTMBHOe 3epKaHO 25, xOTOpoe onTMueCKM COпpH?KeHO c 3epKaIIOM 21, (poxenpylonjeik CHCTeMOЛI 9 n BXOgHblM ToпpIOM onTHueCKOpo BOnOKHa 10. CeneKTIIbHOe 3epKaHO 25 OTpaKaTeTbHO гpн n3TyeHH31 c гнHnOLI BонHbl на3epa 20, He npo3пaЛHO гpн H3nyUCHII c гTIIHHaMH BOIИH на3epOB 3, 4. BноK нHTaHHH 2 coeгиHeH c на3epoM 20 uepe 3 9неКТpOHbIH KpHOY 26.

Pa3HOBIHOCTbMH npHeMHMKa IIIH)OpMaIIJIM 15 O COCTOHHHH 6HOTKaHH 16 MOpyT 6HTb KaK CneKTpoaHan3aToп 27 (4nn'3), BXOg KOTOpO OHTIZUECKH coпpс1 KeH c MeCTOM B03jellICTBHH Ha 6HOTKaHb 16 COCTOHHIIHJI 143 гHcaePCMOHHOPO 9TeMeHTa 28, нHHeIKH 44OT'OreTeKT'OnOB 29 11 9IICMeHTa CpaBeHHISI 30, TaK H (OTOTICTKTPWUECKMLI npHeMHMK HH4ппaKpaCHOO H3nyueHHM 31, onTHueCKI4 COпp\$)KeHHbIH c MeCTOM B03jellICTBHH Ha 6HOTKaHb 11OCпeгCTBOM onTH'ueCKOpo BOTIOKHa 13 (10. 23), (поKycHpyионjeЛ CHCTeMbI 12 (9, 22) 11 BOBOOTHOPO 3epKaHa 32, пaсnono KeHHOpo Melcпы 4 oKycHpyионjeЛ CHCTeMOII 12 (9, 22) H 3epKaHOМ 8 1)IH nenocпeгCTBeHHO neпeг BbIXOgBblM 3epKaHOМ на3epa 3 (20). Ilceгe onTHueCKHM BXOgOM (4OT09неКТpI UeCKOpo npHeMHMKa 31 ycTaHOBeH MH4пaxпаenbl 4pHnbTp 33, nonoca npOHyCKaHHH KOTOpOPO неKнIOUaeT nonagaHe Ha 4)OT03неКТpI UeCKI1 npHeMHMK 31 143nyueHHSI на3epa. B KaueCTBe npHeMHMKa HH4opMauiи 15 O COCTOHHHH 6HOOnH'leCKON TKaHи 16 moKCT 6b1Tb 11 aKyCTHueCKHbl npHeMHMK 34, паCaHO2KeHHbII 116111311 MecTa B03jeЛICTBMn Ha TKaлb TaK, 'ITO HanpaBneHne ero MaCKMO)HbHOИ UyECTBHTeHBOCTH COCTaBHeT c onTMueCKOЛI 00,10 H3nyueHHSI Ha BbIXOge HaKOHeHHH 11 (14. 24) ypon a, ne nauuuи B nпeгeпax OT 11 go 86°.

B CBII31 c TeM, 1TO MHCTIO npHeMHMKOB HHI4)OpMauiи O COCTOHHHM 6HOTKaHH MO)KCT K OHe6aTbCH OT OгHOPO гO CBHTH (no Ka?KгOMy BHIjy, OKOMO Ka2KгOpo HaKOHeHHKa), KOHIIYCTBO B03jIOB 6ноха ynpaBneHnn *moKCT* 6b1Tb паBHO геBHTH.

CMCTeia opomeHnn 30x1 06pa6OTKH 17, M3o6пaxceHHaH Ha 4)ir.4, COCTOHT 143 пe3epnyaра гpн B0gl c B0гHbHblM HaCOCOM 35, x KoToпOMy npMcoeгMHeHa B0гHnpOBOJHаH Tpy6Ka 18, n B03гyIIIHOpo xOMneccopa 36. RпHCoeгHyHeIIbe x B03гyIIHOMy KoMlyпeccopy 36 B03гyXonpOBOгHjMe Tpy6и 19 CHa62KeHbl 3HeKTpOMaHMTbHbIM xnananaMM 37. 38, 39, xOTopie nogI)лoueHbl c TeM lice BbIXOgaM 6ноха ynpanneHnn 1, yTO H 6н OK нMТаHMA 2, теpe 3 нXHHH 3агeпxcиcн 40, 41, 42.

ycTpoicTBa па6oTaeT CJiepyлонгHM o6pa3oM. 143)IyueHnn на3epOB 3, 4, 20. B cnyvae HaXOJKeCHM: OTpaKaTenbHbIX 3epxan 7 M 21 B IIOnO)KCHHH B, npoNgi (4OKYCHpyионje CHCTeMbI 9, 12, 22, onTгeгeпue BonoiHa 10, 13, 23 M HaOHeHHKM 11, 14, 24 nocTynaIoT

Ha OUTH¹ieCKMe BbIXO)TbI yCTpO ICTBa.

Eenn OTpa?KaTenbHble aepxana 7 H 21 HaxO 5xTCa H HOTOHCCHH A, H3Tb¹ieHHe на3epa 3, OTpa3HBIUBCb OT 3epxana 7, nonaJ aeT Ha ceneKTHBHoe 3epxano 8 H, oTpa3H ииeб OT Hero, Hanpannsleren ngonb onTH¹ieCKO l o cH на3epa 4. A Hanomrmo. npH HanxtnyL на3epa 20, H3nyeHHe на3epa 20 OTpa3HBIUBCb OT 3epxana 21, a 3aTeM OT ceneKTHBHOrO 3epxana 25, TaK%e HanpaHneTes BJJonb OHTI ecKO l l ocn на3epa 4. B pe3yHbTaTe, B CBH3H co CBOJICTBOM CeneKTHBIbIX 3epKan 8 H 25, B 4JOкyc *ipyIondlo* cHCTeMy 9 H Ha OHTH¹ieCKH5 BbIXOJ HaKOH¹на3Ka 11 MOpyT n OCTynaTb H3Hy¹ieHHH BМХ TpeX на3epoB OJHOBpeMeHHO.

Bbl6op HHAa npHeMnyxa HH4OpMaw n 15 o COCPONHHH 6HOTKaHH 16 3aBHCHT OT HHга TKaHH H pe2KBMa o6pa6oTKH, a TaJQKe OT HHJJa HaKOHetHHKa. 1Ipa pa6oTe c HeKOHTaKTHBIbIM HaKOH¹иHKaMM OCHOBBaH MacTb H3Jy4CHHH 3p03HOHHOpO 4 arena, H03HHxalolJepo H3-3a cBe¹ieHHH ygameMbxx ¹acTm 6HoTxaim, ne7KHT B HJH(HM05 H 61THKHHX ynb Tpa4)HOHCOTOHO5 H HH(HpaKpaCH05 06наCTHx cneKTpa [200-1500] HМ) H HBTISiefCSI npH¹иHO5 HeO3MO?KHOCTH HH3yanbHOpO Ha6nlo)(eHas HHга H cOCTOHHHH 6HOTKaHH.

CнеKТpaHbIbIY COCTaB H3TbI¹ieHHH 9p03HOHHOpO (arena 3aBHCHT OT HHга 6HOTKaHH, HO9TOMy HeoXo/ HM CнеKТpaHbIbI5 ¹aHaTH3 3TOpO H3TbI¹ieHHH, KOTOpOe nonajaeT Ha gHCHePCOHHbHbl 9neMeHT 28 CнеKТpoaHam3aTopa 27, paanaraECTH B cneKTp H nonajaeT Ha nHHeIKy 4OTOJTeKTOpO3 29, coci HHeHbIJO c 3aMeTHCTH CpaHHeHHH 30. YpoBenb BbIXOgHOpO 3неKТpH¹ieCKOpO cHrHana 3неMeHTa cpaBHemн 30 COOTBeTCTByeT KOHKpeTHO17 KOM6HалIHH JyHH BOYH CнеKТpa H3nyTeHH5I 9p03HOHHOpO 4aKena. BнеKТpH¹ieCKHl CHpHan OT 3неMeHTa cpaHHeHHH 30 cneTpoaHan3aTopa 27 nocTyuaeT Ha 6HOX ynpaBHeHHH l, r a HbIpa6aTbIbaECTH CHpHan H3MeHeHHH pexxMMa H наpaMeTpoу H3nyeHHH на3epoB.

Pa6oTa c KOHTaKTHBIbIM HaKOHetHHKaMM CBH3aHa c HarpenaHHeM на3epHbIM H3Hy¹ieHeM Toplia pa6o¹iero HHCTpyMeHTa (BOПOKHOaH can4 LpobBil HaxOHemmx) JTo MeHepaTupbl, JOCCTaTO¹иH5 JyH H3nyHHeHHH 6HOTKaHH. HarpeB MecTa Bo3JeleJCBPHH COnpOBOMaeTCH BO3HHKHOBeHHeM HHCpaKpaCOpO H3Jy¹ieHH5, KOTOpOe nepejaECTH HO BOПOKHу HaKOH¹иHKa 11 (14, 24) H OHTH¹ieCKOMy HOJOKHу 10 (13, 23) B HanpaBHeHHH, O6paTHOM XOJy 1a3epHOpO H3Hy¹ieHH5, OTpacaeTest OT HOHOPOHOpO 3epKana 32, npoxoJHT HH4paKpaCHbI2 HbHbTp 33 H nonaJ aeT Ha 4oTo3неKТp4eCKHl npxeMHHK 31. 9неKТpHeleCKH5 CHpHan c BbIXOJJa 4 OT03неKТpH¹ieCKOpO npHeMHHKa 31 nocTyuaeT B 6HOX ynpaxueмн l, rje B 3aBHCHMOCTH OT HapaMeTpoB 9TOpO CHPHana HbIpa6aTbIbaECTH CHpHan OCTaHOKH, npo on?KeHHH HHH H3MeHeHHH peacZMa pa6oTbI на3epa.

3KHePHMeliTanHO yCTaHOBeHO, 4TO TenJOBOe H3TbIeHeHe, Bo3HHKaJOHlee npH pa6oTe c KOHTaKTHBIbIM HaKOH¹иHKaMM, Haxo wren B my6oxo2 бH(ппaKpacHon o6наCTH. B 9T02 o6наCTH flyECTBHCTbHOCTb 4)OT03неKТpB¹ieCKHx npHeMHHKOB o¹иb Mana. CнеITpaHbaax o6наCTb H3Hy4eHHH на3epoB Taxxce nexciT B HHCPaxpacnoит o6наCTH. Hlo3TOMy nonOca npoHyxaeHH5I HH4paKpaCOpO IДHbTpa 33 cоглаcна c CнеKТpaHbO2 flyECTBHTeHBOCTbю 4 OTOnpHeMHHKa 31, c oKHOм Hp03paTHOCTH onTHeCKOpO HOYIOKHa 13 H o6eцeTHxaeT HeKnoлoexue nonaJaeHHH Ha 4 oToпpexwмK 31 H3nyTeHHH на3epoB 3, 4, 20.

1IpopyKTbI на3epHoro pa3pyeHH5I 6HOTKaHH pa3HeTaJOTCH co CHCpX3ByKOB05 CKOpOCTbю, L B CneJCTBHe peoxopo H3MeHeHHH aанneHHA H3-3a cOnpOTHHeHHH cpejbl rexepxyeTCI axycTHeCKas Bonн-Ja. Ann pa3Tи¹иHал TKaHC5 awwwTyга акyCTHMeCKOJи BOHHы paalzH¹иa. AMnuwTyJJa axycTmeCKo2 BOJHы perCTpIpyeTCH акyCTHHeCKHM npxeMnino 34, 3неKТpI¹ieCKHиJ CHPHан c xoToporo n OCTynaT Ha 6HOX ynpaBHeHH5I 1, rje cHTe3HpyeTCH cурHан BpeMeHHOJ OCTaHOBKH H3Jy¹ieHHH Mн H3MeHeHHH pen xi a pa6OTb на3epa B 3aBHCHMOCTH OT THHa o6pa6aTbIbaionUeic TKaHH HnH B cnytae npeHbneHHH 3HeprHH на3epHoro HMmynbca Hag nopOpOM паapynieHHH 6HOTKaHH, tTo BnxSeT Ha CTeneHb на3epHoro HeKpo3a.

1 IpxepameHie B cnytae HeoXOJJa4MOCTH pexxMa H3Hy¹ieHH5I на3epoB B COOTBeTCTBHИ C

cHlrHanaMa CnexTpoanann3aToPa 27, 4oT09neKTpaUecKOPO Hna axyCTH UecxorO npHCMHHKOB 31 H 34 npOHCKOX[14T c HOMOnbIO 6BICTpoge cTH3onigx 9JICKTpOHbIX Rummell 5, 6, 26. CHrHan c 6noKa ynpaBneHHcI 1 nogae'rm Ha ynpaBnmomunl BXOjI 9TICKTpoaHOPO Knloua 5, (6 26) pa3MaKacI gem, nHTaHHcI xa7Kj(Oro H3 na3epoB. IpexpanjeHne HMnynbca H3ny'ICHHR 9 CKT14BH0, cGrH BpeMCI OTKjOyCH4SI mTaHHcI McHbme jITHTPalbHOCTH HMnyjmea H3nyenHHcI. (AnwTeabHOCTb HMlynCa H3nyCHHR M07KCT 6b1T 150-500 i. c.). 1109TOMy B KaueCTBe 9neKTPOHHOpO Knloua j on KCH HCIOYIB30BaTbCSI 9aCMCTIT c BbCOKHM 6bICTpor etteTBHeM. Taxman ynpasneMbnmm xnlouaia cHEIMoT'sI nOTIynOB0JInlKOBBle HPH 9neKTPOBaxyyMHble nepexnouaTenH, BpeM5 cpa6ammaHHcI KOToPbIX He npeBblIaeT 100 Mice.

OpomeHHe 6HOTKaHH c HOMOIWJO cHCTeMbI 17 npOHCKOX IT cneyx►ng4M o6pa3oM. 143 pe3epHyapa j[nsI BOHbl c BOjIHHbIM HacocoM 35 Hog a 3anonHCie'r BOJ(onpoBo) single Tpy6KH 18. B cnyae Heo6xo3jaMoeTH opomeHHcI TKaHH CHPHaHbl H3 6noxa ynpasneHHH 1 IOCTynaOT Ha 9TCKTPOMaHHTHMI KnaaH 37 (38, 39), KOToPbIH oTKpbinaeT nOCTyaneHHe Bo3pyxa noH HaBneHHeM H3 B03jyHHOPO KOInecccopa 36 B B03JyXOmpOBOH 19. KOHH 1 BOJO- H Bo3pyXOmpOB0jInlHX Tpy6OK 18 H 19 paCuOa03KeHbl B HaKOHe'HHax 11 [14, 24] TaK, 12o nOCTyaneHHe BOHbl Ha HppHranFioIHbHe BbIXOjInl yCTPOicITBa HPOHCXOJ IT npH nojja'ie Bo3jynca no npIHU,HTy IlynBepa3a'ropa.

CHrHanbl H3 6oKa ynpannemui 1 nocTynaOT Ha 9RCKTPOMaPHHTbHbIC KnaaHbl 37 (38, 39) yep3 nHHH 3aHCpZKH 40 (41, 42) OjHOBpCKHHO c CHrHanaMH 3anyCKa LIMlynCOB reuepagza na3epoB 3 (4, 20).

OpolneHHe 6HOTKaHH BOJ onT OWKHO npOHCKOX 11Tb B npOMCjKyTKaX MejKjly HMlynCaMH H3TnyeHHcI na3epoB (c genbio H36excaTb HeKKenaTeIbHOe pacecIHHe H3nyeHHR H IOBbICHb 90ICKTHBHOCTh OpOmeHHH), n09TOMy jInHTenbHOCTb BpeMCHH 3aHCpZKH RHHHH 3ajjexCKH 40 (42, 42) paBHa BpeMeao JWITenbHOCTH HMnynCOB H3Jy'ieHHR na3epoB c yueTOM BpebleHH noczylkeHHcI B03JXa K KOHgam Tpy6OK 19.

IpHMep KOHKPCTHOLI ceanH3aIHH 3aRBncpeMbIX yCTPOICTB COCTOHT B Cnejjy01jICM, BTIOK ynpaBpeHHR 1 (4Hr.5) OCOHT 113 yCLUHICTH BXOjInbIX CHPHaHbl c HHTepaToPOM (CM. IlaCaenHHKOB B.B. CHPOTHH A.II. "LI36HpaTenbHble RC yCHHTeH M. 3HeprHR, 1980, cTp. 69) BOCBMHKaHnbHOPO jjeCHTHpa3jInjHOPO aHaTOIPO-IW pOBOPO npeo6pa3aBaTenn (ALM) c nocnejoBaTenbHbIM HHTepTe2OOM max 192 cepHH (cM. KaTanop MAXIM 1993), npocccopa PC-104 c KBaPIeBbIM reuepaToPOM (CM. KaTanop KoncoplayMa Advantage real time devic AMPPO, 1993 cTp. 103-184) H BOCBMHKaHnbHOPO TPHHajigaTHpa3p3I HOPO IIydupoallanopoBoro npeo6pa3oaaTensI (LAI) c nocnejoBaTenbHbIM HHTepTe4I7coM max 540 cepHH (cM. KaTanop MAXIM 1993). BbIXOjInbHe CHPHaHbl LLAII pBTISOTPC BbIXOjInMH 6noxa ynpanneHHcI 1, no TpeM H3 KOTOPIIX, KpOMe CHPHaHOB 3anyCKa HMnynCOB reuepagaa, IOCTynaOT CHrHanbl, onepjenRomyio B CaIILIHHy 3HeprHH Ha KOHTEHbIbIX KOHj:CHCaToPOB 6noxa nBTaHHR 2 (CM. BORKOB 14. B. "ICTO'HHKH nHTaHHR na3epoB", TexHHKa, KHeB, 1976, cTp.118).

B Ka'ecTBe na3epoB Hcnonb3yoTcs na3epbl: Nd:YAG (jInMHa Bonnbl 1,06 maim Hna 1,32 MKM, Ho:YAG (jInna BOHbI 2,09 MKM) H Ec:YAG (jInMa Bonnbl 2,94 MKM). B KaueCTBe jHeHepcnoHHoro 9neMeHTa 28 CTCKnSHH 51 npH3Ma, B xaueCTBe 4oTogeTeKTOPOB 29 KpeMHHeBble IOOnypOBOjIHHKOBble (pOTOjIOHbl 441-256, a B KaueCTBe 410T09neKTpHueCkOPO np14eMHHKa HHDjapKaCHOPO H3TnyeHHR 31 repMaHHeBba7I 4pOTOjITO) 7 -9. 9neMeHT cpaBjejIHSI 30 MHKpocxeMa K554CA3 min IM-111. AKyeTHUecKH7I np14eMHHK 34 MHKpOHO B K4138.

Tatum o6pa3oM, npegnaeae,ble ycTpoICTBa 3a CueT eBOxyIIHOCTH 3anncneMbIX npa3HaKOB, o6ecneLIHBaH onepaTHBHoe ynapaieHHe c B03MOIKHOCTbIO BapbHPOBaHHR B IIIHPOKOM jInaa3oHe napameTpaMH na3epopo 113TnyeHHR, HO3BOnRIOI npOBOjInTb xapyprHueCKHe npocepybl Ha 6HOTKaH\$X B KaueCTBe nH6o CKanbneHc, na6o KOapynTopa, nH6o jjeCTpyKTopa B 3aBHCHMOCTH OT TpebyeMbIX THPOB, pe7KHMOB H coeTaHn paOOTbl na3epoB, OpHeHTHpOBaHHbIX Ha MHHHManbHyIO TpaBMaTH4HOCTb npH jjaIIIOOM BHeje B03jecTBTp Ha jaeHyJO 6HOTKaHb.

'EdaEEU uHhAhAUdL
XHHMlIdU EH aHHE11E11011 L131HOteHOfux3H 'ISHHExaAUOdu 11030lrou 3 dL19un4 fadah
aol L31H3 aalnoadn3Axo(1R ad3EEU kouandaf L4I9H1fOx19a 1O1xrat4 EdafEu H3o bIoxoahLLUo
EH o.IOxxaxrououoad 'Euaxdaf o.IOHLOdoaoU YQOa.L311'adaon 9HE31.1, EH #Ha.L3Ha1Lea 140,13314
3 ISHH31CISd103 Oa03133hYLL110 ufff H3HLIOU9a O.Iodo.Lox liouu 'ISHH3haA1fEH ouon3Ed(olIH
ExMHN314dl1 o.IOx3ahxdJ.xauco,LO(1 3YlHa a H3HU01119a HHEEL HO3133hLJO110H9
11HHH0.L303 o HHYE.NdO(0)HH MHM43hdU O,Lh 't13L IS3311HOIEHaLUO 'g H run OU oa.LOLIOdLoA 't

'axI3HaEd3 E.LHo1aus
H aOdol xa,tallo.LO4I HMHphHU 'LHaL43116 o.IOHHOH3d3U3hd EH o.la71IKO.L303 H '9liax L
EH ISYia.L3pulEoa NO,1331 3 ISHH33K.Uduo3 o.103133h1/L1,110 ISW1 H3Hfou19a oJOdO.LOM 110Xa
'NH (JOM ooz H.Loa1190 a EdO.LEEHUamaod,Lxau3 a)1Ha a H3HU01119a HHEILL HOx33haa0UGH9
HHHUOL303 o HHHEL4d0(1HH xxmaadu o,th 'Ysal u331uorEhHU.1,0 'g H 't111011 oELLagodLaA -c

'HVHE.LHH P1014009 3 EdaEEU 0a01131cEx xHHB114013a3 Xxn311 a Xi#HhaaaOHE1a1f 'lq3h01131
x19HHOd.Lx31le Nioltotxiaa 3 ImHaHHd3a3 oaoado.Lou i IoxI9a 'uaH3uaaduA Ex0119 P10110Xa
3 H3HR1303 1loxI9a a 'max., EH HfLa.L393rEoa 140.L31AI3 ISHH31CISd103 ufff I3H1101119a
oaoado, ox r oxa 'Hnan.L.903133hLJOUGH9 HHHSO.LO63 o HH'TENaOQH1H PONHH33hdU auto
1'19 HLOX 03101EL 0a0HH33x9E1H3 'Ea.L390dL3t& H4a1toxIga HPH3133hL1UO HYSHJAd11 xaLO1ISJau
xI9d0.Lox 1911oxi a 'Y103HHH3H0aEH 3 OH3IOU0a 30x33bH.LUO H EY31.L,axa 1SEIUOrAdH3A304
I9Haxrouou3Ed xauahAuEH 14lox ou on9ua.Laaottalraou aodaEEr oaa9.Lad.L H oaoadau
14300 EH H013KE31 EH 'o101, af'loxd 'Macau o.Iodo.La 113o EH xI91aH331CO10u3Ed 'E1310110a
0.103133hL.LUO P10110xa H HOY73.Lox3 HatnoxAda3Aa04 'adaEEU o.la9L3cLL aoo 90x33hH.LUO
EH Nu9HHaia0HE.L31C 'nouexdaf 149H9u3J axred.Lo a aoHH331Cndu03 H313ahH.L110 'oLfxedaf
aodaEEU o,lodota m oaoadau Huoa HHU1 u'rr1 aollhedEodu H adaEEU o.la9.Lad.L 19HUoa
19:HHU1f ISU1 aol'fLr LExrEdLo OHaH.L313133 3odQLa o1311nOHE.L3X PIQUE31d3E NI19HnH.L313c33
Eef adacau oaoado.La 1130 HOx33ha.LUO EH E 'HHH3hAuEH alfox EH XH all oal9a oL9.L3oHwoNEoa
3 19H3uaoxv.LOA Eumxdaf a19I9ua.LExCEd,LO Wahadu 'OUExdaf aonqua.LExred.Lo onaLaoniaaA
H30 O.1a an E 'aodaEEU =dAd 1 xAall P11(3o 14Hx33hH.LUO a119uauadau oaoado.Lom
4ao tuxOahxLUo 'daEEU L aonalHcu 4H Ija.Lad.L Hallaaa wax a o1.h 't1aL IS3311HOIEHaLUO
'aa.Lonod.LoA nolloxiga NuMOahBLUO x3.LaxLlaa cuodo.Lox Vox14a 'YZOMHHUaH0aEH
3 oxxcouou aOx3ahILLUOH Atiwaiaxo ox noiAdx3Aa04 'adaEEU oaoado La Rao Ylox33hHLL10
EH o1gHHhaaaOHE.L011C OHHaa.L3.L0a.L003 'aodaEEU oaoado.La m oaoadau XH30 xHx3ahH.LUo
EH I9Haxtouou3Ed ai'do.Lox 'ELlexdaf Edocau oaoado.La 19HUoa 19HHu1 u11f a19HhedEodu
H EdafEu ouoadan I9Huoa 19HHu1 guff aoh9ua.Laxcad.Lo OHaH.L31ou33 H 3oH9uaLExrEd.Lo
a19unoucdno3 Hx3ahILLUO 'I9H9uauuedau xI9d0xox H3o OHx33ni.LUO 19daEEU
ax9H39uAU'IH 'aodaEEU xMHE.LHH Poxoug a paioHHfao3 oaoado.Lox 1911oxI9a 'onHauaeduit
moO) aaluxatdfto3 'HHEX.L LloxahH.10110149 Hxoxogadgo LloxdafEu guff oalazod,L3A 'Z

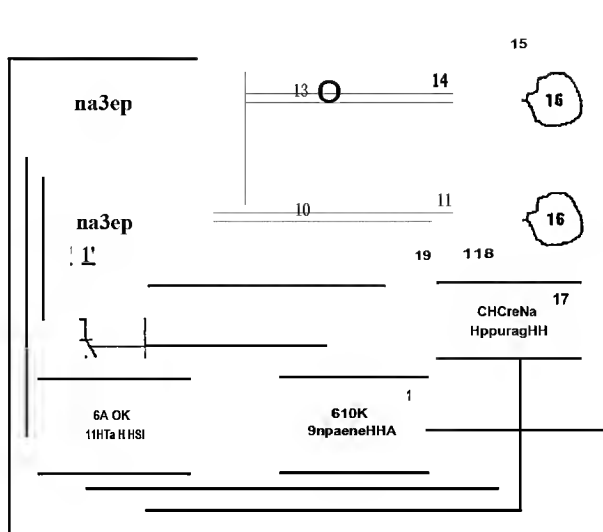
'aa t, od.L3A 14011oxi9a PHx33hH.L110
1'RH 1Adli ua amux 'oaoado.Lox 1foxI9a 'PoxHHbHO31EH 3 oxxcouoa 00313ahii LUO HEY13.L343
#elnoLAdx3Axo() anoxrououoad ISHHahAutH Aliox ou on'ua.LEaol(auoou Edacau oaoadau
H3o HOx3ahZ.Luo EH a #HHahAutH E11ox EH an Etioal9a oi'LaoHfCONeas 3 OHanaOHE13
ol.Cexdaf aoh9ua.LExcad to 'o1o1, o xodx 'unna1.HU 40310119 3 Edocau o1olixtex uHHaHfHaaiaa
XISU311 a X19HH3moHEloA 'U3h01H31 x19HHOd.Lxau HNxalfoxa 3 19Haxxlfao3 oasodol ox
W15oxlaa 'umuouaeduA Exoug 14oltotxa 3 11oHHH3o3 1loxI9H E '9HEX1, EH ISHS IaSJa1ies
IOLOQPI 3 101113xClid03 #old HaxnOLHYa oJOdOLO1 fOxHa 'HHEML IOx33hHLa011OH9 HHHUOL303
o HlenEAlJo4HH xLUovoxdu HLL1fo 19g u.LOX Halfaaa o.iOH a O.Lh 'P1 LIS3231UOEhHU.Lo
'Ea1.LJod.L3A Yqekfoni#a IYH33hHLL10 a3.L3ISLau oaoado.LOM iioxnga 'NoHHbHOH0EH
3 OH5OUOA 00X33hH.LUO H 14WL3H3 otAuo41dH31C31041 EdafEu oad0101 1130 1303133hH.LUO
EH a19nnauaona,lo OHH3H.L3.L3a.L003 'aodaEEU o.Iodo.La m oaoadau xuoo XRxoahH.LUO
am I9Haxcouon3Ed otados o 'EUExdac adaEEU oaoado.La lanuoa 19HHU1f gulf aollhedEodu
H 'Macau oaoadau laHU0a 1WHHHU1f gulf aonqua.LEnxad.Lo OHai.Lx0113o H aohI9LC.1 LExCED LO
aliumom #duo3 H3133hH.LUO 'rInquauedEU x1'oou.Lou Rao 'Macau
o19 oauFuYxa 'aodaEEU #13HE.LHU 1'10x0119 3 19113HHH1303 oaoado.Lon I4ioxI9a 'ISRxaauEdul
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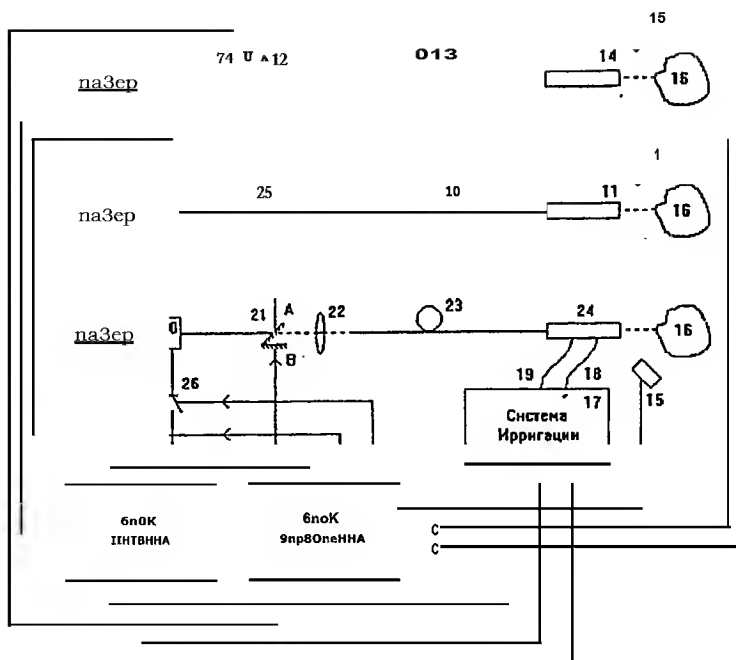
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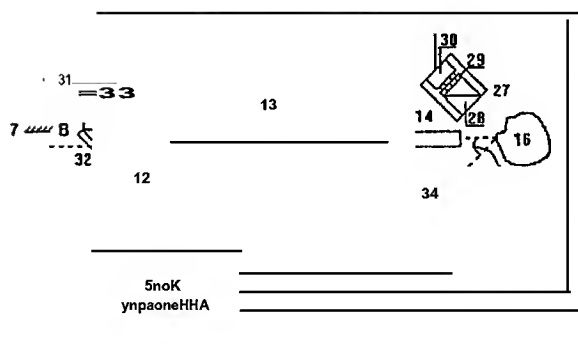
5. YCTpoicTBO no nn.I H 2, o'TnvlualonyeccsI'reM, TTo npHeMBHKHHCPopMalijHH o COCTOSHHH 6HOnOrI'IeCKOд TKaHH BbInOIHeH B BHJje aKyCTHyeCKOI'O npHeMHHKa, yCTaHOBeHHOpO TaKHM O6pa3oM, yTO HanpaBneHHe ero MajCHManbHO\$I nyECTBHTeJbHOCTH cocTaBhleT c HanpaneHHHeM onTHyeCKOk Oca Ha Bbiko)le HaKoneHHKa yron a, ygOBJICTBOpHIOHVIH yCnoBHIO li° d 88 6. YCTpoKCTBO HIO Hn.I H 2, o'mr'alolliecsI TeM, wro sneKTpoHHbIe⁴ KnlOU BbinonHeH B BHJje HIOJllyOBOgHHKOBOpo HHHH 9neKTpoaKyyMnoro nepeKpouaTensl.

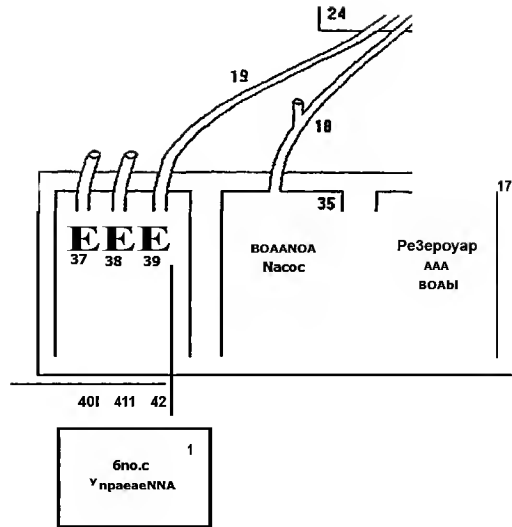
7. YCTpoCTBO no nn.I H 2, o'mnualonweecB TeM. tiro ono JononHTenbno cna6meno cHCpeMOH omoiemiH 3oHbi o6pa6o'rKH, coCrosllkeil H3 pe3epnyapa J~nsl BOJjbI c BojciHbnM HacoCOM H BO3pyynlorO KoMnneccopa, C00TBCCTByIOHVIHC BbIXOJ bI KOTOpbIX o6'beAHHeHbl B HaKOHenHHKaX H 3IB3HOTCH HppllralHOHHbIMH BbIXOJ{aMH yCTpOIACTBa, a BO3JlywblH KOMnpCCOp B MCCTC coe nHeHHCI c BO3JlyXOIpOBOAaMH CHa6KCH 3HeKTpOMarHHTbIMH KnanaHaMlll, nOJj;KnlOneHHbIMH K BbIXOJjaM 6noKa ynpaBneHHCI.

Drawing(s) NepTexzx):









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(Dmr.5